INTEGRATED SCIENCE 4

CALIFORNIA CONTENT STANDARDS: BIOLOGY/LIFE SCIENCES	2003 Blueprint	%
Genetics	**2**	**3.3%**
5. The genetic composition of cells can be altered by incorporation of exogenous DNA into the cells. As a basis for understanding this concept:		
a. *Students know* the general structures and functions of DNA, RNA, and protein.	✓	
b. *Students know* how to apply base-pairing rules to explain precise copying of DNA during semiconservative replication and transcription of information from DNA into mRNA.	✓	
Physiology	**11**	**18.3%**
9. As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment. As a basis for understanding this concept:		
a. *Students know* how the complementary activity of major body systems provides cells with oxygen and nutrients and removes toxic waste products such as carbon dioxide.	✓	
b. *Students know* how the nervous system mediates communication between different parts of the body and the body's interactions with the environment.	✓	
c. *Students know* how feedback loops in the nervous and endocrine systems regulate conditions in the body.	✓	
d. *Students know* the functions of the nervous system and the role of neurons in transmitting electrochemical impulses.	✓	
e. *Students know* the roles of sensory neurons, interneurons, and motor neurons in sensation, thought, and response.	✓	
f.* *Students know* the individual functions and sites of secretion of digestive enzymes (amylases, proteases, nucleases, lipases), stomach acid, and bile salts.	NA*	
g.* *Students know* the homeostatic role of the kidneys in the removal of nitrogenous wastes and the role of the liver in blood detoxification and glucose balance.	NA*	
h.* *Students know* the cellular and molecular basis of muscle contraction, including the roles of actin, myosin, Ca^{+2}, and ATP.	NA*	
i.* *Students know* how hormones (including digestive, reproductive, osmoregulatory) provide internal feedback mechanisms for homeostasis at the cellular level and in whole organisms.	NA*	
10. Organisms have a variety of mechanisms to combat disease. As a basis for understanding the human immune response:		
a. *Students know* the role of the skin in providing nonspecific defenses against infection.	✓	
b. *Students know* the role of antibodies in the body's response to infection.	✓	
c. *Students know* how vaccination protects an individual from infectious diseases.	✓	
d. *Students know* there are important differences between bacteria and viruses with respect to their requirements for growth and replication, the body's primary defenses against bacterial and viral infections, and effective treatments of these infections.	✓	
e. *Students know* why an individual with a compromised immune system (for example, a person with AIDS) may be unable to fight off and survive infections by microorganisms that are usually benign.	✓	
f.* *Students know* the roles of phagocytes, B-lymphocytes, and T-lymphocytes in the immune system.	NA*	
TOTAL in Biology/Life Sciences	**13**	**21.7%**

*Not assessed

INTEGRATED SCIENCE 4

CALIFORNIA CONTENT STANDARDS: CHEMISTRY	2003 Blueprint	%
Atomic and Molecular Structure	**0**	**0.0%**
1. The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure. As a basis for understanding this concept:		
g.* *Students know* how to relate the position of an element in the periodic table to its quantum electron configuration and to its reactivity with other elements in the table.	NA*	
h.* *Students know* the experimental basis for Thomson's discovery of the electron, Rutherford's nuclear atom, Millikan's oil drop experiment, and Einstein's explanation of the photoelectric effect.	NA*	
i.* *Students know* the experimental basis for the development of the quantum theory of atomic structure and the historical importance of the Bohr model of the atom.	NA*	
j.* *Students know* that spectral lines are the result of transitions of electrons between energy levels and that these lines correspond to photons with a frequency related to the energy spacing between levels by using Planck's relationship (E = *hν*).	NA*	
Chemical Bonds	**3**	**5.0%**
2. Biological, chemical, and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules. As a basis for understanding this concept:		
d. *Students know* the atoms and molecules in liquids move in a random pattern relative to one another because the intermolecular forces are too weak to hold the atoms or molecules in a solid form.	✓	
e. *Students know* how to draw Lewis dot structures.	✓	
f.* *Students know* how to predict the shape of simple molecules and their polarity from Lewis dot structures.	NA*	
g.* *Students know* how electronegativity and ionization energy relate to bond formation.	NA*	
h.* *Students know* how to identify solids and liquids held together by Van der Waals forces or hydrogen bonding and relate these forces to volatility and boiling/melting point temperatures.	NA*	
Gases and Their Properties	**0**	**0.0%**
4. The kinetic molecular theory describes the motion of atoms and molecules and explains the properties of gases. As a basis for understanding this concept:		
g.* *Students know* the kinetic theory of gases relates the absolute temperature of a gas to the average kinetic energy of its molecules or atoms.	NA*	
h.* *Students know* how to solve problems by using the ideal gas law in the form *PV = nRT*.	NA*	
i.* *Students know* how to apply Dalton's law of partial pressures to describe the composition of gases and Graham's law to predict diffusion of gases.	NA*	
Acids and Bases	**2**	**3.3%**
5. Acids, bases, and salts are three classes of compounds that form ions in water solutions. As a basis for understanding this concept:		
b. *Students know* acids are hydrogen-ion-donating and bases are hydrogen-ion-accepting substances.	✓	
d. *Students know* how to use the pH scale to characterize acid and base solutions.	✓	
Chemical Thermodynamics	**3**	**5.0%**
7. Energy is exchanged or transformed in all chemical reactions and physical changes of matter. As a basis for understanding this concept:		
a. *Students know* how to describe temperature and heat flow in terms of the motion of molecules (or atoms).	✓	
d. *Students know* how to solve problems involving heat flow and temperature changes, using known values of specific heat and latent heat of phase change.	✓	
e.* *Students know* how to apply Hess's law to calculate enthalpy change in a reaction.	NA*	
f.* *Students know* how to use the Gibbs free energy equation to determine whether a reaction would be spontaneous.	NA*	

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Nuclear Processes	**2**	**3.3%**
11. Nuclear processes are those in which an atomic nucleus changes, including radioactive decay of naturally occurring and human-made isotopes, nuclear fission, and nuclear fusion. As a basis for understanding this concept:		
a. *Students know* protons and neutrons in the nucleus are held together by nuclear forces that overcome the electromagnetic repulsion between the protons.	✓	
b. *Students know* the energy release per gram of material is much larger in nuclear fusion or fission reactions than in chemical reactions. The change in mass (calculated by $E=mc^2$) is small but significant in nuclear reactions.	✓	
c. *Students know* some naturally occurring isotopes of elements are radioactive, as are isotopes formed in nuclear reactions.	✓	
d. *Students know* the three most common forms of radioactive decay (alpha, beta, and gamma) and know how the nucleus changes in each type of decay.	✓	
e. *Students know* alpha, beta, and gamma radiation produce different amounts and kinds of damage in matter and have different penetrations.	✓	
f. * *Students know* how to calculate the amount of a radioactive substance remaining after an integral number of half lives have passed.	NA*	
g.* *Students know* protons and neutrons have substructures and consist of particles called quarks.	NA*	
TOTAL in Chemistry	**10**	**16.7%**

*Not assessed

INTEGRATED SCIENCE 4

CALIFORNIA CONTENT STANDARDS: EARTH SCIENCES	2003 Blueprint	%
Earth's Place in the Universe	**8**	**13.3%**
1. Astronomy and planetary exploration reveal the solar system's structure, scale, and change over time. As a basis for understanding this concept:		
b. *Students know* the evidence from Earth and moon rocks indicates that the solar system was formed from a nebular cloud of dust and gas approximately 4.6 billion years ago.	✓	
d. *Students know* the evidence indicating that the planets are much closer to Earth than the stars are.	✓	
e. *Students know* the Sun is a typical star and is powered by nuclear reactions, primarily the fusion of hydrogen to form helium.	✓	
2. Earth-based and space-based astronomy reveal the structure, scale, and changes in stars, galaxies, and the universe over time. As a basis for understanding this concept:		
a. *Students know* the solar system is located in an outer edge of the disc-shaped Milky Way galaxy, which spans 100,000 light years.	✓	
b. *Students know* galaxies are made of billions of stars and comprise most of the visible mass of the universe.	✓	
c. *Students know* the evidence indicating that all elements with an atomic number greater than that of lithium have been formed by nuclear fusion in stars.	✓	
d. *Students know* that stars differ in their life cycles and that visual, radio, and X-ray telescopes may be used to collect data that reveal those differences.	✓	
e.* *Students know* accelerators boost subatomic particles to energy levels that simulate conditions in the stars and in the early history of the universe before stars formed.	NA*	
f.* *Students know* the evidence indicating that the color, brightness, and evolution of a star are determined by a balance between gravitational collapse and nuclear fusion.	NA*	
g.* *Students know* how the red-shift from distant galaxies and the cosmic background radiation provide evidence for the "big bang" model that suggests that the universe has been expanding for 10 to 20 billion years.	NA*	
Energy in the Earth System	**5**	**8.3%**
4. Energy enters the Earth system primarily as solar radiation and eventually escapes as heat. As a basis for understanding this concept:		
a. *Students know* the relative amount of incoming solar energy compared with Earth's internal energy and the energy used by society.	✓	
5. Heating of Earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents. As a basis for understanding this concept:		
d. *Students know* properties of ocean water, such as temperature and salinity, can be used to explain the layered structure of the oceans, the generation of horizontal and vertical ocean currents, and the geographic distribution of marine organisms.	✓	
California Geology	**2**	**3.3%**
9. The geology of California underlies the state's wealth of natural resources as well as its natural hazards. As a basis for understanding this concept:		
a. *Students know* the resources of major economic importance in California and their relation to California's geology.	✓	
TOTAL in Earth Sciences	**15**	**25.0%**

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CALIFORNIA CONTENT STANDARDS: PHYSICS	2003 Blueprint	%
Heat and Thermodynamics	**9**	**15.0%**
3. Energy cannot be created or destroyed, although in many processes energy is transferred to the environment as heat. As a basis for understanding this concept:		
a. *Students know* heat flow and work are two forms of energy transfer between systems.	✓	
b. *Students know* that the work done by a heat engine that is working in a cycle is the difference between the heat flow into the engine at high temperature and the heat flow out at a lower temperature (first law of thermodynamics) and that this is an example of the law of conservation of energy.	✓	
c. *Students know* the internal energy of an object includes the energy of random motion of the object's atoms and molecules, often referred to as *thermal energy*. The greater the temperature of the object, the greater the energy of motion of the atoms and molecules that make up the object.	✓	
d. *Students know* that most processes tend to decrease the order of a system over time and that energy levels are eventually distributed uniformly.	✓	
e. *Students know* that entropy is a quantity that measures the order or disorder of a system and that this quantity is larger for a more disordered system.	✓	
g.* *Students know* how to solve problems involving heat flow, work, and efficiency in a heat engine and know that all real engines lose some heat to their surroundings.	NA*	
Waves	**2**	**3.3%**
4. Waves have characteristic properties that do not depend on the type of wave. As a basis for understanding this concept:		
c. *Students know* how to solve problems involving wavelength, frequency, and wave speed.	✓	
Electric and Magnetic Phenomena	**5**	**8.3%**
5. Electric and magnetic phenomena are related and have many practical applications. As a basis for understanding this concept:		
a. *Students know* how to predict the voltage or current in simple direct current (DC) electric circuits constructed from batteries, wires, resistors, and capacitors.	✓	
b. *Students know* how to solve problems involving Ohm's law.	✓	
c. *Students know* any resistive element in a DC circuit dissipates energy, which heats the resistor. Students can calculate the power (rate of energy dissipation) in any resistive circuit element by using the formula Power = IR (potential difference) x I (current) = I^2R.	✓	
k.* *Students know* the force on a charged particle in an electric field is qE, where E is the electric field at the position of the particle and q is the charge of the particle.	NA*	
l.* *Students know* how to calculate the electric field resulting from a point charge.	NA*	
n.* *Students know* the magnitude of the force on a moving particle (with charge q) in a magnetic field is $qvB \sin(a)$, where a is the angle between v and B (v and B are the magnitudes of vectors v and B, respectively), and students use the right-hand rule to find the direction of this force.	NA*	
o.* *Students know* how to apply the concepts of electrical and gravitational potential energy to solve problems involving conservation of energy.	NA*	
TOTAL in Physics	**16**	**26.7%**

*Not assessed
Adopted by SBE 10/9/02

INTEGRATED SCIENCE 4

CALIFORNIA CONTENT STANDARDS	2003 Blueprint	%
Investigation and Experimentation	**6**	**10.0%**
1. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations. Students will:		
a. Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.	✓	
b. Identify and communicate sources of unavoidable experimental error.	✓	
c. Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.	✓	
d. Formulate explanations by using logic and evidence.	✓	
e. Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.	✓	
f. Distinguish between hypothesis and theory as scientific terms.	✓	
g. Recognize the usefulness and limitations of models and theories as scientific representations of reality.	✓	
h. Read and interpret topographic and geologic maps.	✓	
i. Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).	✓	
j. Recognize the issues of statistical variability and the need for controlled tests.	✓	
k. Recognize the cumulative nature of scientific evidence.	✓	
l. Analyze situations and solve problems that require combining and applying concepts from more than one area of science.	✓	
m. Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.	✓	
n. Know that when an observation does not agree with an accepted scientific theory, the observation is sometimes mistaken or fraudulent (e.g., the Piltdown Man fossil or unidentified flying objects) and that the theory is sometimes wrong (e.g., the Ptolemaic model of the movement of the Sun, Moon, and planets).	✓	
TOTAL	**60**	**100%**

*Not assessed